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(71) Applicant *(for all designated States except US)*: CARLSBERG A/S [DK/DK]; Vesterfælledvej 100, DK-1799 Copenhagen V (DK).

(72) Inventor; and
(75) Inventor/Applicant *(for US only)*: RASMUSSEN, Jan, Nørager [DK/DK]; Rytterbakken 22, DK-3650 Ølstykke (DK).

(74) Agent: HOFMAN-BANG & BOUTARD A/S; Adelgade 15, DK-1304 Copenhagen K (DK).

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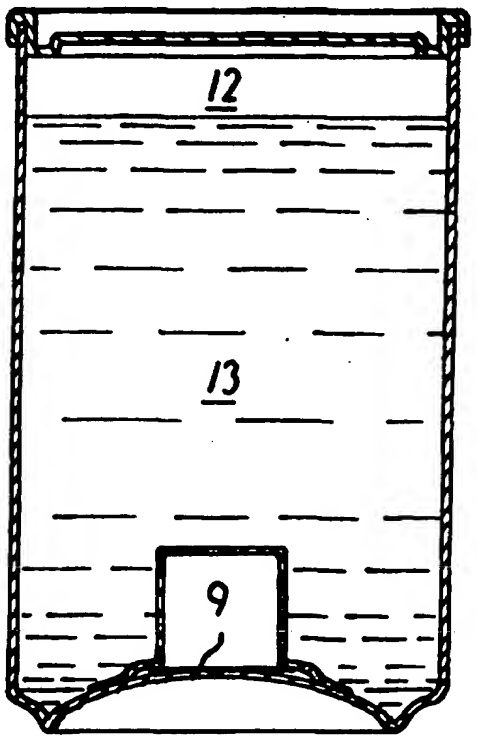
(54) Title: FOAM PRODUCTION FOR BEVERAGES

(57) Abstract

The invention relates to a method of producing a container of beverage having means to promote the formation of foam by ejection of gas through an orifice from a chamber within the container when the container is opened. The container comprises a first chamber for receiving the beverage and a second chamber that communicates with the first chamber through said orifice. The new aspects of the invention are, that after filling the container with beverage and sealing the container, a barrier that separates the first chamber and the second chamber is breached, thereby bringing the second chamber into communication with the first chamber through the orifice, allowing the second chamber to equilibrate with the first chamber. The invention also relates to a container for beverage and an insert for such a container.



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Foam Production for Beverages

This specification relates to the production of foam for beverages. The specification is particularly, but not exclusively, concerned with the production of a head of foam on beer dispensed from relatively small containers such as cans, bottles and the like.

Whilst many systems exist for providing a stable, tight head on beer dispensed from casks and other bulk containers, it has long been recognised that there are problems if seeking to achieve the same effect on beer dispensed from containers such as cans and bottles. Any head tends to come from the natural effervescence of the beer as dissolved carbon dioxide comes out of solution when the container is opened, and from excitation of the beer as it is poured into a glass. To a certain extent the head formation can be improved by using a combination of nitrogen and carbon dioxide, but simply doing this does not produce a head as good as that on beer pumped from casks and the like. There is a particular problem in the case of canned beers intended to provide similar qualities to traditional draught beers, where there is a significantly lower CO_2 content than in other canned beers.

It has therefore been proposed to inject gas into the beverage when the container is opened, so as to promote the formation of bubbles which will provide the foam. This has been done by providing a secondary chamber containing gas at above atmospheric pressure, which is ejected into the main beverage through an orifice when the container is opened, due to the pressure difference across the relatively small orifice. In some known arrangements the secondary chamber communicates with the body of the container via a valve. These are known as "closed" systems.

Such an arrangement is described in WO 91/07326 where a secondary chamber is provided in the container in the form of a plastics insert which is pre-charged with nitrogen under pressure. This gas is retained within the insert by means of the valve. However, the properties of the valve are altered after the container has been filled so that, when the container is opened, the resultant pressure differential across the valve causes it to open and allow the gas to be ejected.

At least one container of this type is currently in commercial use for packaging beer. However, this arrangement has certain drawbacks. Firstly, the construction of the insert is necessarily complex, and therefore expensive. Secondly, the valves may deteriorate over time which limits the shelf life of the inserts before they are put into containers.

An alternative, and mechanically simpler, arrangement uses a secondary chamber which is in permanent communication with the remainder of the container. Various designs have been proposed for these so-called "open" systems.

In GB-A-1,266,351 there is disclosed a bottle with a cap having a secondary chamber attached to it. This is in permanent communication with the main body of the beverage and contains gas under pressure, at equilibrium with the remainder of the bottle. There are also disclosed cans with secondary chambers in their bases, which are provided with valves. Similar arrangements are shown in GB-A-1,331,425.

In GB-A-2,183,592 there is provided a secondary chamber in the form of a plastics insert which is pushed down inside a can. The chamber is provided with an orifice which communicates permanently with the main body. After sealing the can, beverage enters the insert to compress the gas therein, which is normally nitrogen. It is stated

that subsequent ejection of gas and/or beverage causes the formation of a head. The insert is in the form of a plastic moulding.

A modified version of this system is described in GB-A-2183592. Here, an insert is placed within a container, as previously described, but after the can has been sealed it is rapidly inverted so that the chamber within the insert communicates via the orifice with the head space in the container. Subsequently, there is an increase of pressure within the container which forces gas from the headspace into the insert. The container is subsequently pasteurised whilst inverted. It is then righted and allowed to equilibrate. This arrangement results in a larger amount of gas within the insert and therefore improved foam production.

Open systems have proved to be successful commercially and are widely used. However, one problem which arises with the use of an open system is that air can be trapped within the secondary chamber. This can be serious because oxygen can react with beverages such as beer causing them to spoil. In order to prevent this from occurring, it is known to flush the beverage container with "inert" gases such as nitrogen or carbon dioxide which do not spoil the beverage in order to displace the oxygen. Clearly, this has to be done immediately before the container is filled with beverage and this can both slow down and complicate the filling line. Standard filling lines in, for example, breweries are designed to run at very high speeds, and anything which reduces their speed of operation can have a serious effect on their profitability.

One approach to overcoming this problem is described in WO 93/25452. Here, an insert is used which has been blow moulded using nitrogen and is initially completely sealed. The insert is punctured to provide a communicating orifice only as it is placed within the container.

However, this system still has a drawback because in order to prevent oxygen from diffusing into the insert via the orifice, the container must be filled and sealed soon after the insert is located therein.

According to a first aspect of the present invention there is provided a method of producing a container of beverage having means to promote the formation of foam by ejection of gas through an orifice from a chamber within the container when the container is opened, said container comprising a first chamber for receiving the beverage and a second chamber that communicates with the first chamber through said orifice, characterized in that after filling the container with beverage and sealing the container, a barrier that separate said first chamber and said second chamber is breached, thereby bringing said second chamber into communication with said first chamber through said orifice, allowing said second chamber to equilibrate with said first chamber.

Preferably the barrier is breached by increasing the pressure and/or temperature within the container. The second chamber may also preferably be divided into major and minor parts by the barrier, the minor part being provided with an orifice communicating with the first chamber, and the major part being initially sealed from the minor part by the barrier.

It will be seen that the container produced by the method of the invention uses the well known "open" system which has been found to be both reliable and successful. Thus, the pressure in the second chamber is increased after the container has been sealed so that when the container is opened, gas is ejected through the orifice to promote the formation of foam. However, the method of the invention has the significant advantage over the prior art that the second chamber initially contains little or no oxygen. It may, for example, be filled with a gas which is inert

with respect to the beverage in question such as nitrogen, or it could be evacuated. Therefore, the amount of oxygen or other gas which might taint the beverage in the second chamber is reduced and so the amount of flushing or other steps is reduced or eliminated.

Preferably, the volume of major part of the second chamber is much larger (e.g. more than five or ten times larger) than the minor part and therefore only a small proportion of the second chamber can be contaminated by oxygen. Ideally, the minor part has such a small volume, say only 5% of the total, that no flushing is required.

The barrier between the first and second parts of the second chamber may be in many forms. For example, it could comprise a valve having means to hold it closed which means are destroyed by temperature or pressure. Such a valve does not serve the same purpose as prior art valves which open only when the container is opened. The valve will be open already, with there being communication between the second chamber and the first, beverage containing, chamber. However, preferably the barrier is in the form of a frangible membrane. The membrane may be heat sensitive, but presently it is preferred to use a material which can be broken as a result of a pressure differential across it. It is particularly preferred for the membrane to be rupturable as a result of pressure changes which occur in the container as a result of the normal container filling or subsequent pasteurisation stages.

In order to prevent accidental rupturing of the membrane it is preferred that a comparatively high pressure differential is required to cause rupturing to occur and therefore preferably the membrane is designed to rupture during the pasteurisation stage when the pressure within beverage containers can reach around 80 to 90 psig.

Preferably the cross section of the communication between the major and minor parts is much greater than the cross section of the orifice, or of the combined cross sections if more than one orifice is used.

The precise manner in which the second chamber becomes pressurised can vary. It is possible for the orifice to be located away from the bottom of the second chamber and to allow beverage to flow into the second chamber after the container has been sealed. This reduces the internal volume of the second chamber and thereby pressurises gas trapped therein. On opening the container, the trapped gas escapes through the orifice and causes foam production in the known manner.

However, in order to give the maximum foam production for a given size of second chamber, as much gas as possible should be trapped within that chamber and therefore beverage should ideally be excluded, in particular in relation to low-carbonated beverage. It is therefore particularly preferred that the second chamber be in communication with the head space in the container when the barrier is breached so that gas from the headspace may flow into the second chamber. This may conveniently be achieved by locating the orifice near the bottom of the container and inverting the container after it has been sealed. Preferably, the container is pasteurised whilst inverted. In this way, when the barrier is breached, a large amount of gas will be driven into the second chamber by the high pressure within the container.

The barrier (e.g. membrane) will prevent the beverage from entering the major part of the second chamber before inversion takes place. Consequently, the container does not have to be pasteurised immediately after filling, but can be stored until the most convenient time.

In a high-carbonated beverage, however, it would be preferred that some beverage enters the second chamber, when the barrier is breached. This may be achieved by placing the second chamber in connection to the sidewall of the container in a position where it in all times is surrounded by the beverage irrespective of whether the container is inverted or not. When the barrier is breached beverage will float into the second chamber trapping the now pressurized gas within this chamber. This is in particular interesting in connection with high-carbonated beverage to avoid an initial explosion-like reaction, when the container is opened. The initial reaction will be far more gently, when beverage flows through the orifice that connect the second chamber with the first chamber. When the second chamber in this way is located away from the bottom of the container yet another effect is present: the jet from the second chamber only reacts with the beverage placed above the second chamber. This means that when the beverage is poured into a glass, the beverage from beneath the second chamber flows through the upper and already reacting beverage causing further reaction of the beverage.

The present invention also extends to a container for use in such a method and therefore viewed from a second aspect the invention provides a container for beverage having means to promote the formation of foam by ejection of gas through an orifice from a chamber within the container when the container is opened, said container comprising a first chamber for receiving the beverage and a second chamber that communicates with the first chamber through said orifice, and that the second chamber is sealed from the first chamber by a barrier which is breachable by the effects of temperature and/or pressure.

The container may be integrally formed, for example having the second chamber provided in a false bottom. Alternatively, the second chamber may be formed as a discrete

insert, as is known in, for example, GB 2183592. Presently, it is preferred to produce the second chamber by means of an insert which may be used in combination with a conventional container such as a drinks can, but it is not essential that the insert provides a complete second chamber, and the minor part may be only partly defined. Thus, the second chamber is preferably provided by means of an insert which has an open end which is bonded, by means of adhesives or welding etc. to the base of the container, thereby substantially closing the insert with the container base forming a wall of the minor part of the chamber. This construction makes more economical use of materials, and simplifies construction of the insert since the insert does not have a closed shape. Thus, the insert may be generally in the form of a cup which may be pressed into shape and the barrier subsequently added.

Preferably, a flange is provided to ensure good seal between the insert and the container. A further flange-portion may be provided within the insert onto which a frangible membrane forming the barrier is bonded.

Such inserts themselves are inventive and therefore viewed from a third aspect the invention provides an insert for a container for beverage having means to promote the formation of foam by ejection of gas through an orifice from a chamber within the container when the container is open, and that said insert comprises a hollow body defining a major chamber part, which is sealed by means of a barrier from a minor chamber part, the major chamber part being closed and containing substantially no oxygen, and there being an orifice in the body leading to the minor chamber part.

As discussed above, the minor part may be permanently closed in order to form a discrete insert. However, preferably the insert is arranged to be sealed against the base of the container, thereby closing the minor part of

the chamber. A further advantage of this design is that it is easy to construct from metal such as aluminium, e.g. by pressing or turning, and therefore the insert may be recycled along with a standard aluminium can in which it is incorporated.

Two embodiments of the invention will now be described, by way of examples only, and with reference to the accompanying drawings in which:

Figure 1 is a sectional view through a container body before the container is filled with beverages;

Figure 2 is a perspective view of an insert for using the container of Figure 1;

Figure 3 is a sectional view of the insert of Figure 2;

Figures 4a to 4d are sectional views similar to Figure 1 illustrating the stages of producing a container of beverage; and

Figure 5 is a sectional view through a container body in another embodiment of the invention.

Figure 1 illustrates the body of a standard beer can before it has been filled or sealed in which an aluminium insert 2 is mounted. The insert is bonded to the domed portion 3 of the bottom of the can which it is shaped to compliment.

As may be seen in Figure 2, the insert 2 is generally in the form of a top hat. The upper part 4 is hollow and provides the major part of the interior volume of the insert. Surrounding the upper part is a flange 5. This has an outermost portion 6 the underneath of which is contoured to match the domed portion 3 of the base of the container. Adhesives or bonding agents such as epoxy may

be provided on the underside of this part for bonding onto the domed portion of the can. One method is to apply an adhesion coating in the form of a lacquer and then to place the insert in an oven for 10 minutes to harden the coating. Alternatively, the insert could have a plastic coating on the aluminium (as in a sandwich construction) and then one could weld it directly to the can. The inner part 7 of the flange 5 is arranged to be slightly vertically displaced from the domed portion 3 of the can. A small orifice 8 is provided through the wall of the inner part.

As may be seen in Figure 3, a foil or plastics membrane 9 divides the inside of the insert 2 into two parts. The membrane is welded directly against the face of the inner part 7 of the flange. The two parts are pressed together using a welding tool for 5 seconds at 250°C. The orifice 8 is not obstructed. The membrane defines a major upper part of the insert 10 which lies above it, and a minor part 11 which lies between it and the domed portion 3 of the base of the can when the insert is bonded in position. The domed portion is shown in phantom in Figure 3. As may be seen in that figure, the orifice communicates with the minor part 11 which occupies only a small part of the internal volume of the insert 2. The major part 4 contains an inert gas such as nitrogen at 1 atmosphere pressure.

In order to produce a container of beverage, the insert is bonded to the base of a standard beer can, as shown in Figure 1. The bottom of the container may be abraded to assist in bonding. The insert is then welded to the can using a welding tool, the parts being held together for 10 seconds at 250°C. As the insert has only a small volume (minor part 11) in which air may be trapped, and is made of aluminium which is impermeable to oxygen, it is not necessary to flush it. The next stage is to fill the

can with beer containing 1.0 vol/vol CO_2. A drop of liquid nitrogen is then added to the surface of the beer and the can is then sealed. The situation is then as illustrated in Figure 4a. The quantities of gases within the can are such that the pressure within the container reaches 40 psig within 20 seconds at the filling temperature of the beer which is typically 1°C.

Subsequently, the can is inverted, as shown in Figure 4b so that the orifice 8 is located in head space 12 above the beer 13. The can is then pasteurised for 30 minutes at 62°C. This causes a significant rise in pressure within the can. When the pressure reaches 80-90 psig, the pressure differential across the membrane 9 is sufficient to cause it to rupture, as is shown in Figure 4c. This allows gas from the head space 12 to flow via the orifice 8 and the remains of the ruptured membrane into the major part 10 of the insert 2. Thus, the insert becomes filled with pressurised gas.

Finally, the can is turned the right way up and allowed to cool and equilibrate, as shown in Figure 4d. The can may then be distributed. When it is opened at its serving temperature, gas is ejected from the insert via the orifice in the known manner, forming a jet. This jet provides nucleation sites within the beer which causes gas to evolve from the beer in the form of tiny bubbles which rise to the surface to provide a head of foam.

Figure 5 shows another embodiment of the invention where the second chamber is placed in connection to the sidewall and above the bottom of the can. The second chamber is secured to a plate which is connected to the wall by one or more spokes 14, the connection to the plate being in the same way as the connection to the bottom of the can previously described. The spokes 14 may be secured to the sidewall of the can in a common way, e.g. by adhesive

bonding. In the embodiment shown in figure 5 the second chamber will in all times be surrounded by the beverage irrespective of whether the can is inverted or not. This means, that when the beverage is pasteurised and the barrier 9 breaches, according to the increasing pressure within the can, beverage will flow through the orifice 8 into the second chamber trapping the now pressurized gas in the second chamber. When opening the can, and thereby releasing the pressure inside the can, beverage will flow out through the orifice 8 starting the foam-making process. If in high-carbonated beverage only gas is flowing through the orifice 8 the initial reaction will be somewhat explosion-like, often causing the beverage to overflow the can. In contrary, when beverage at the starting point is flowing through the orifice 8 the initial reaction will be much more gently.

In practice, the can will be filled with many others using a high speed filling line. Since there is no premature action of the insert during filling, a "black fill" (i.e. no foaming on release of the counter pressure) may be obtained and so line speeds of, say, 1,500 cans/minute can be used. Since there is a black fill, can to can variation in pressure is reduced.

Patent Claims:

1. Method of producing a container of beverage having means to promote the formation of foam by ejection of gas through an orifice from a chamber within the container when the container is opened, said container comprising a first chamber for receiving the beverage and a second chamber that communicates with the first chamber through said orifice, characterized in that after filling the container with beverage and sealing the container, a barrier that separate said first chamber and said second chamber is breached, thereby bringing said second chamber into communication with said first chamber through said orifice, allowing said second chamber to equilibrate with said first chamber.

2. Method according to claim 1, characterized in that the barrier is breached by increasing the pressure and/or temperature within the container.

3. Method according to claim 1 or 2, characterized in that the container is filled with beverage so as to leave a head space.

4. Method according to any one of claims 1 to 3, characterized in that the second chamber being divided into major and minor parts by the barrier, the minor part being provided with an orifice communicating with the first chamber, and the major part being initially sealed from the minor part by the barrier.

5. Method according to any one of claims 1 to 4, characterized in that the second chamber before sealing is initially filled with a gas, which is inert with respect to the beverage.

6. Method according to any one of claims 1 to 5, characterized in that the gas is nitrogen.

7. Method according to any one of claims 1 to 6, characterized in that the equilibration between the first and second chamber causes only gas to enter the second chamber.

8. Method according to any one of claims 1 to 6, characterized in that the equilibration between the first and second chamber causes only beverage to enter the second chamber.

9. Container for beverage having means to promote the formation of foam by ejection of gas through an orifice from a chamber within the container when the container is opened, said container comprising a first chamber for receiving the beverage and a second chamber that communicates with the first chamber through said orifice, characterized in that the second chamber is sealed from the first chamber by a barrier which is breachable by the effects of temperature and/or pressure.

10. Container according to claim 9, characterized in that the second chamber is divided into major and minor parts, the minor part communicating with the first chamber through the orifice and the major part being sealed from the minor part by the barrier, the major part being initially free of oxygen.

11. Container according to claim 10, characterized in that the volume of the major part of the second chamber is more than five times larger than the volume of the minor part of the second chamber.

12. Container according to any one of claims 9 to 11, characterized in that the barrier of the second chamber is provided by a frangible membrane.

13. Container according to any one of claims 9 to 11, characterized in that the barrier of the second chamber is provided by a valve.

14. Container according to any one of claims 9 to 13, characterized in that the second chamber is provided as a false bottom.

15. Container according to any one of claims 9 to 13, characterized in that the second chamber is provided at the inner sidewall of the container.

16. Insert for a container for beverage having means to promote the formation of foam by ejection of gas through an orifice from a chamber within the container when the container is opened, characterized in that said insert comprises a hollow body defining a major chamber part, which is sealed by means of a barrier from a minor chamber part, the major chamber part being closed and containing substantially no oxygen, and there being an orifice in the body leading to the minor chamber part.

17. Insert for a container according to claim 16, characterized in that the minor part is permanently closed in order to form a discrete insert.

18. Insert for a container according to claim 16 or 17, characterized in that the barrier is a membrane which is substantially not oxygen permeable.

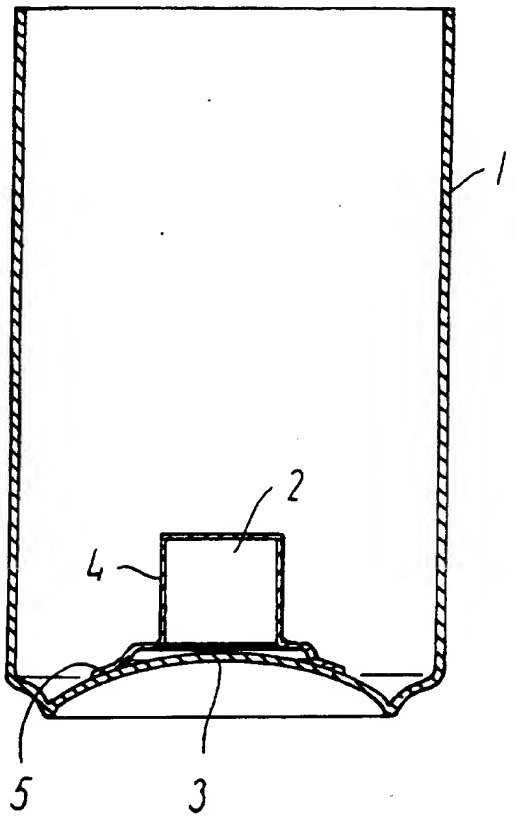

FIG. 1

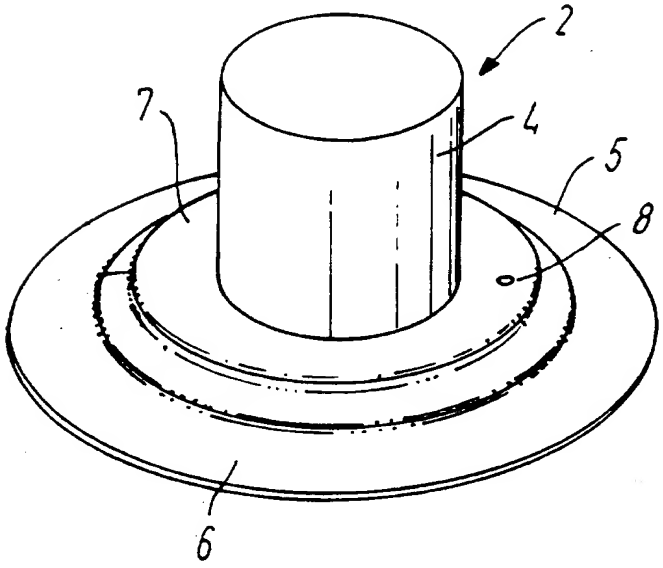

FIG. 2

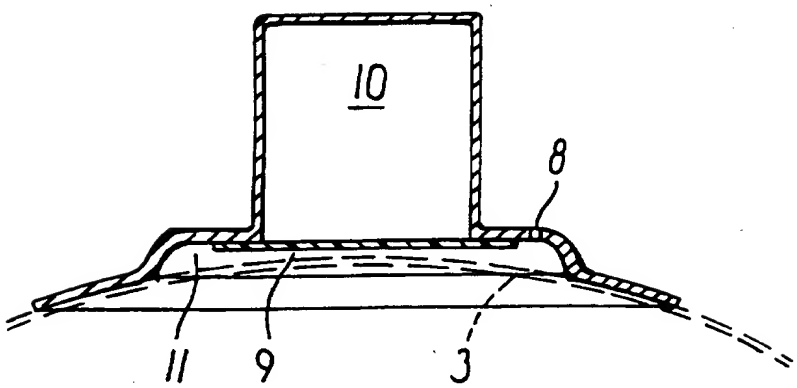

FIG 3

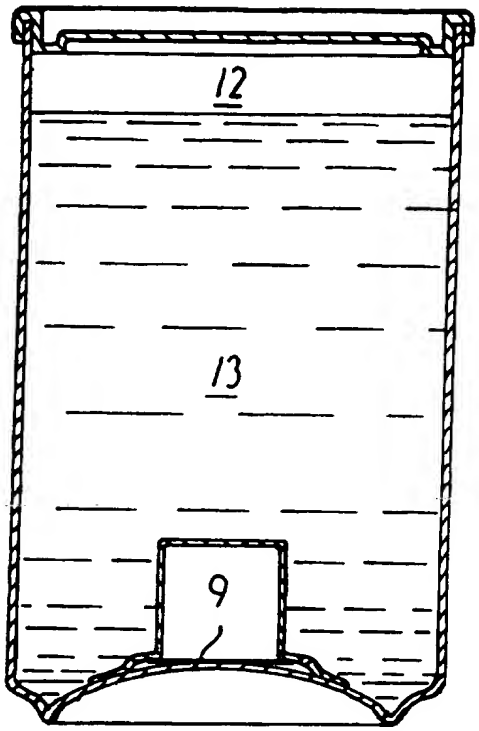

FIG. 4A

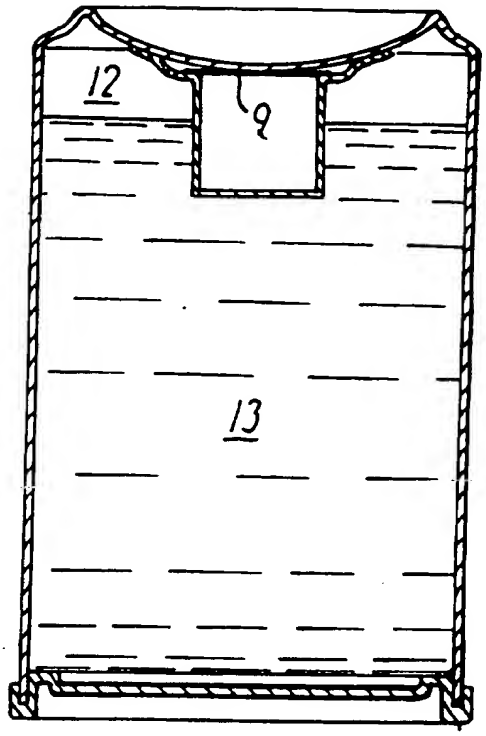

FIG. 4B

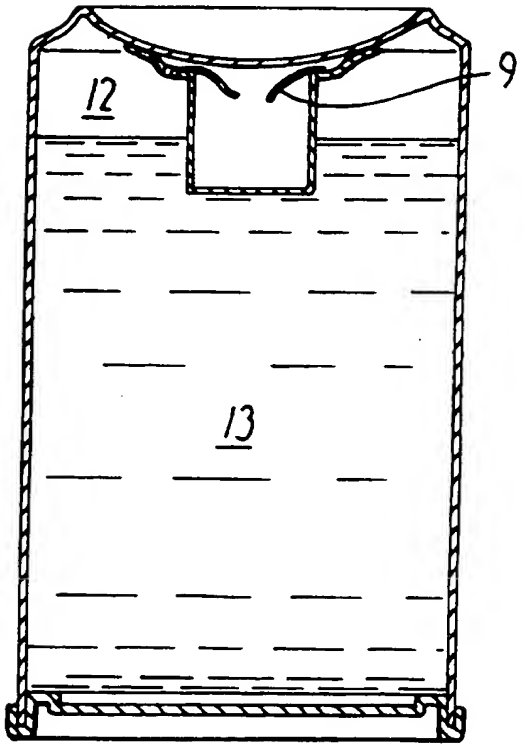

FIG. 4C

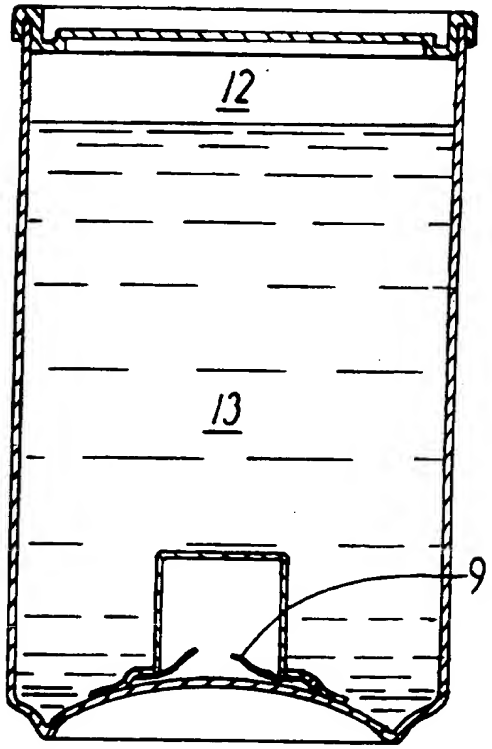

FIG. 4D

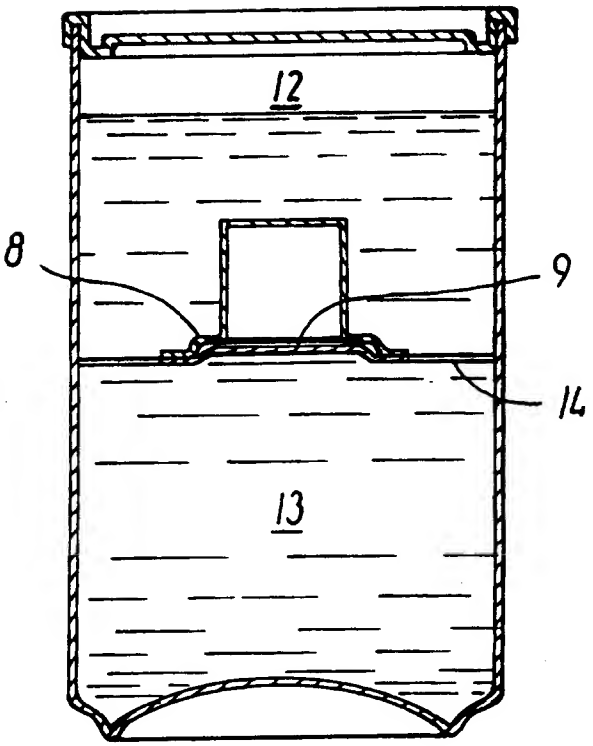

FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/DK 95/00521

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: B65D 79/00, B65D 85/72, B65D 25/08 // B65B 29/10
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: B65D, B65B, B67D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

DIALOG

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB 2273693 A (PA CONSULTING SERVICES LIMITED), 29 June 1994 (29.06.94), abstract --	1-3,5-9,13
X	EP 0577284 A2 (GUINESS BREWING WORLDWIDE LTD.), 5 January 1994 (05.01.94), column 8, line 49 - column 10, line 3; column 11, line 44 - column 12, line 24, figures 3-8 --	1-3,5,6,9,12
X	GB 2211478 A (E J PRICE (DEVELOPMENTS) LIMITED), 5 July 1989 (05.07.89), figure 3, abstract --	1,9,12,14,15

[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
19 April 1996	25/04/96
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer HELENA ÅKERLUND Telephone No. +46 8 782 25 00

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INTERNATIONAL SEARCH REPORT

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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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A	WO 9109781 A1 (WHITBREAD & COMPANY PLC. ET AL), 11 July 1991 (11.07.91), figures 1-21, abstract	1-18
P	WO 9509118 A2 (AMERICAN NATIONAL CAN COMPANY), 6 April 1995 (06.04.95), figures 1-20, abstract	1-3,5-9,12
P	WO 9506605 A1 (PAKTEK LIMITED), 9 March 1995 (09.03.95), page 11, line 29 - page 12, line 21, figures 5-9	1-18
P	WO 9500415 A1 (WHITBREAD PLC ET AL), 5 January 1995 (05.01.95), figures 1-13, abstract	1-18

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